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Feasibility study of biogas production and utilization as a source of renewable energy in Malaysia

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ABSTRACT

Nowadays, energy consumption is rising rapidly due to industrialization and progress in the standards of living. Fossil fuel such as natural gas, petroleum and coal which are mentioned as the most important energy sources in the world are depleted day by day and these non-renewable resources become rare soon. Moreover, environmental issues have become a dilemma due to more fossil fuel consumption. Recently, the conspicuous developments have been performed in untapped befoul resources which are environmentally friendly to fulfill the energy demand of the world. The combustion characteristics of befoul can be similar to fossil fuel by adapting some strategies. Many countries have invested in befoul as a favorable source of energy in research, production and export areas. Malaysia as a tropical country has numerous befoul resources generated from agricultural production especially palm trees from photosynthetic process. Palm industry byproducts such as the palm oil empty fruit bunch (POEFB), monocarp, shell and palm oil mil effluent (POME) can be developed to extract biogas as an acceptable source of energy. On the other hand, without suitable strategies these valuable resources can threat the environment by air and water pollution. This article is a feasibility study of biogas production and utilization as a source of renewable and sustainable energy in Malaysia and discusses about some appropriate strategies which should be taken into account to decrease environmental problems which have been created by oil palm factories.

Contents

1. Introduction

The industry as a backbone of the economy can conspicuously effect the standard of humankind [1]. The status of industrial development, transportation and agricultural sectors in the world are completely affiliated to the fossil fuels situation. However, fossil fuel resources are limited and transitory [2]. Fossil fuel depletion and environmental issues have convinced the academic society and governments to research about new fuel resources and to invest unsustainable energy resources. Global attention to alternative fuel has been more highlighted when international crisis in the energy issues, climate change as well as fossil fuel depletion have driven the world toward dilemma problems. Recently, bioenergy sources like animal and agricultural wastes,

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municipal solid wastes and waste water effluents as the renewable energy sources have attracted attentions and applied for preparing a fraction of global energy demand [3].

1.1. Air pollution

Economic development and progress in the industry cannot obtain be without energy consumption. However, global warming and air pollution are the main consequences of more fuel utilization [4,5]. Recently, global warming has become one of the main concerns of industrial countries. Greenhouse gases (GHG) emission into the atmosphere is cited as the main parameter for global warming phenomena. The emissions released from fossil fuels in transportation systems organize the considerable part of GHG and an urgent demand for applying renewable fuels is observed [6]. The importance of this request is more highlighted when statistics show that the rate of CO_2 emission has increased around 1.6 times in recent 30 years. Several pollutants such as NO_x, CO, CO_2, and SO_2 are released to the environment by fossil fuel combustion in industrial sectors. Greenhouse impact and acid rain are the negative effects of these pollutants [7]. Global warming has been occurred due to the more GHG production and CO_2 emission constitutes around 72% of total GHG, therefore CO_2 is the most important emission in global warming occurrence. The rate of CO_2 emission production has been increased during last 50 years and it is still rising. Climate change is one of the key parameters which convinced governments to take biofuel into account in their energy supply policy. According to the Kyoto Protocol (KP) in 1997, industrial countries should reduce the pollutants by at least 5% below 1990 levels. New policies in renewable energies and environmental issues should be taken into account to obtain this excellent goal [8].

1.2. Water pollution

Oil palm as a source of edible oil has been cultivated vastly in west and central Africa and Asian tropical countries like Malaysia, Indonesia and Thailand. In Malaysia palm oil industry has become one of the most important businesses. The palm oil extraction process requires a plenty of water for extracted oil clarification and palm fruit bunches sterilization. Also, oil palm millprocess needs large quantity of water for its operation. Therefore, a huge amount of POME is expected to release from palm oil industries. Around 0.87 m^3 POME is released when one tone of palm fruit is milled in the factory [9]. Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are the main effects of POME in which can consequence serious water pollutants. On the other hand, POME has been introduced as a potential source to produce renewable bioenergy such as biohydrogen and biomethane through anaerobic digestion. Therefore, a combination of renewable and sustainable bioenergy strategy and wastewater treatment should be taken in palm oil industries [10]. The dissolved solids in the effluent menace the environment and receiving water resources such as rivers, streams and ocean. The soluble organic matters in discharged POME can threat the life of marine creatures due to increase bacteria and decrease oxygen in the water [11,12]. In some oil palm industries the wastewater is discharged to the environment after some preparations and pollutants elimination from effluent. In these pretreatments the suspended solids are omitted by physical treatments like sedimentation and floatation units, screening and grit chamber. However, the soluble solids are usually removed chemically or biologically [13].

2. Palm oil production in Malaysia

Malaysia is a tropical country located in the South East Asia. The temperature does not fluctuate very much during the year due to its equatorial climate. The rainfall averages 200–250 cm per year in Malaysia and effective photosynthesis have prepared excellent circumstances for agricultural activities. In recent decades, the palm oil industry has become a source of livelihood to rustic families as well as recruitment opportunities to agricultural workers in Malaysia [14]. Table 1 illustrates the biomass resources in Malaysia and the amount of their estimated potential [15].

The rate of energy demand has increased in Malaysia due to new industrialization conditions and it is prognosticated that Malaysia would get into trouble because of fossil fuel resources depletion [69]. Table 2 shows the rate of energy demand from 2000 to 2010 in Malaysia [16].

Transportation and industrial sectors are the main energy users in Malaysia by 40.3% and 38.6% respectively, and the energy demand increases at a rate of 5–7% per year during next 20 years from 2004 [17]. Recently, the price of petroleum has been increased globally and Malaysian government has paid a lot of subsidies to keep the cost of fossil fuel fixed in transportation sector. Therefore, feasibility study about renewable fuel resources as petroleum substitution has become one of the Malaysian government policies [18]. As palm oil is the most common harvest in Malaysia, the government has designed some programs like Malaysians Palm Oil Board(MPOB) to develop bioresources production through palm oil industry [19]. Based on these strategies Malaysia has become one of the largest countries in biomass production which applies palm oil as feedstock. According to statistics Malaysia produces around 42.3% of worldwide palm oil.

Table 1
Biomass resources and their estimated energy potential in Malaysia [13].

Type of industry	Production (mton)	Type of biomass	Residue generated (mton)	Calorific value of biomass (kJ/kg)	*Potential energy generated (mton)
Oil palm	59.8	Empty fruit bunches	12.30	18,838	5.53
		Fronds and trunk	21.10	–	–
		Fiber	8.75	19,068	3.99
		shell	3.94	20,108	1.89
Paddy	2.14	Palm kernel	2.11	18,900	95
		Rice husk	0.47	15,324	0.17
		Rice straw	0.86	13,620	0.28
Sugar	1.11	Bagasse	0.36	8021	0.069
Wood	1.67	Sawdust	0.96	19,008–19,188	0.44
	0.3	Plywood residue	0.069	10,000–19,000	0.024
Municipal solid waste	11,940 t/day	Municipal solid waste	–	9500	–

* Potential energy generated (ton) = residue generated (ton) × 1000 kg × calorific value(kJ/kg)/41,86,8000 kJ

Table 2
Energy demand in Malaysia 2000–2010 [16].

Source	Petajoules			Average annual growth rate	
	2000	2005	2010	8 MP (%)	9 MP
Industrial	477.6(38.4%)	630.7(38.6%)	859.9(38.8%)	5.70	6.40
Transport	505.5(40.6%)	6613(40.5%)	911.7(41.1%)	5.50	6.60
Residential and commercial	162.0(13.0%)	213.0(13.1%)	284.9(12.8%)	5.60	6.00
Non-energy	94.2(7.6%)	118.7(7.3%)	144.7(6.5%)	4.70	4.00
Agriculture and forestry	4.4(0.4%)	8.0(0.5%)	16.7(0.8%)	12.90	15.90
Total	1243.7(100%)	1613.7(100%)	2217.9(100%)	5.60	6.30

Furthermore, 48.3% of global palm oil export is done by Malaysia. Malaysian government has led this country to utilize biofuel in industrial sectors, transportation and export by national biomass polices. By applying these strategies the petroleum dependence can decrease and clean environment is expected in future [20]. In environmental aspect, Malaysia has been pledged to reduce 40% of its CO_2 emission by 2020 in comparison with the year 2005 in United Nations Climate Change Conference (UNFCCC) Copenhagen 2009. The target which has been programmed by National Biofuel Policy (NBP) is applying biofuel as the best substitution for conventional fuel in transportation and industrial sectors to acquire environmental standards [21,22]. Palm oil production sustainability has become controversial topic. Especially non-governmental organizations (NGOs) have propounded serious questions in this case. Destruction of animal habitat and deforestation which are the main consequences of further palm oil industry expansion has been claimed by NGOs [23]. Not only plantation sector, but also the sustainability of palm oil mill process has been questioned. POME is significant pollutant which is released from palm oil mills [24]. Therefore, without appropriate strategies in palm oil mills, air and water pollution is avoidable. These dilemmas have been more highlighted due to increase the number of mills. According to statistics the number of palm oil factories in Malaysia increased from 10 factories in 1960 to 410 mills in 2008 [14]. Hence, biomass and palm oil concepts which have been announced by MPOB should be comprehensive to overcome all of the environmental problems.

3. Palm oil empty fruit bunches (POEFB)

Oil palm which is the main crop plantation in Malaysia is one of the most important sources of vegetable oil in the world. The total production of crude palm oil (CPO) in Malaysia and Indonesia was more than 35 million tons in 2010 [25]. One of the staple byproducts of CPO production factories in Malaysia is POEFB as a non-wood lignocellulosic waste material. These valuable byproducts are usually applied as a fuel in the factories furnaces causing environmental pollution [26]. However, POEFB can be applied as a renewable material source for biogas generation [27]. POEFB as a non-wood material consists of organic matter and it has significant potential to be applied for biogas production [28,29]. By taking suitable strategies and well-organized arrangements POEFB can be utilized as a good source for biogas generation. POEFB application as a fuel is not appropriate process to extract energy from these materials due to irreversibility of burning process and air pollution via combustion. Also, the left materials after the POEFB anaerobic digestion can be applied as a rich fertilizer for new crops cultivation. Commercially, biogas is generated from waste materials and energy crops like waste water sludge, manure and municipal solid waste, but biodegradability of various waste materials different due to different structure of their composition. During anaerobic process the degradability of starch and sugars is very high, proteins and lipids are intermediate and cellulose is renitent [30]. Biodegradability and the sum of the cellulose and lignin content of various waste streams have a kind of reverse correlation. In the other words the higher cellulose and lignin content show lower biodegradability [31]. Therefore, a pretreatment should be applied to open up the compressed structure of lignocellulosic materials and enhanced their biodegradability. Various methods such as chemical, physical, mechanical, biological and thermal have been applied as pretreatments [32]. For example in some countries like Denmark, manure is one of the most important biogas resources due to their high animal production. The biodegradability of manure is very low as the lignocellulosic biofibers content is very high. In order to decompose the lignocellulosic feedstock some pretreatment should be done. With steam treatment in high pressure and temperature (around 180) the substratum is treated and the rate of methane production from digested manure increases up to 67% [33]. Although, the increased methane production has been reported in mechanical pretreatments by the particle size reduction, these implements are not economical due to their high energy consumption [34]. Fox et al. [35] stipulated that pretreatment with alkaline can improve the biological alteration of lignocelluloses. It has been reported that this chemical pretreatment method is promising for anaerobic digestion ameliorating of corn stalk, softwood, hardwoods, paper tubes and newspaper [36,37]. Mirhamidi et al. [38] classified pretreatments with NAOH into "high concentration (typically with NaOH of 6–20%)" and "low concentration (typically with NaOH of 0.5–4%)" processes. High temperature and pressure are mentioned as the main prerequisites of low concentration NaOH pretreatment to be efficient, and NaOH is not reusable in this process due to reactive destruction mechanism of lignocelluloses. Lignin and hemicellulose can efficiently descompose in this process [32]. However, pretreatment with high-concentration of NaOH can be implemented at low temperature and ambient pressure. The decomposition process of lignocelluloses can be improved due to mitigation of cellulose crystallinity in this process. One of the most important advantages of high concentration NaOH pretreatment in economic and environmental aspects is the reusability of NaOH [30]. Phosphoric acid was applied to improve the enzymatic hydrolysis of lignocellulosic materials by Zhang et al. [39]. This process is able to decompose the lignocelluloses' structure. Furthermore, reusability of the phosphoric acid has been mentioned as one of this method's privileges [39]. Danay et al. [30] applied NaOH and H_3PO_4 as pretreatment methods to improve biogas production from POEFB in a batch reactor. Fig. 1 illustrates the results of their experiments in thermophilic conditions during seven days and one month. It can be seen that 100% improvement in methane production was obtained when NaOH was applied in pretreatment process for 60 min [30].

4. Palm oil mill effluent (POME)

For every one ton fresh fruit bunches production in the mill process around 5% shell, 12% mesocarp, and 23% empty fruit

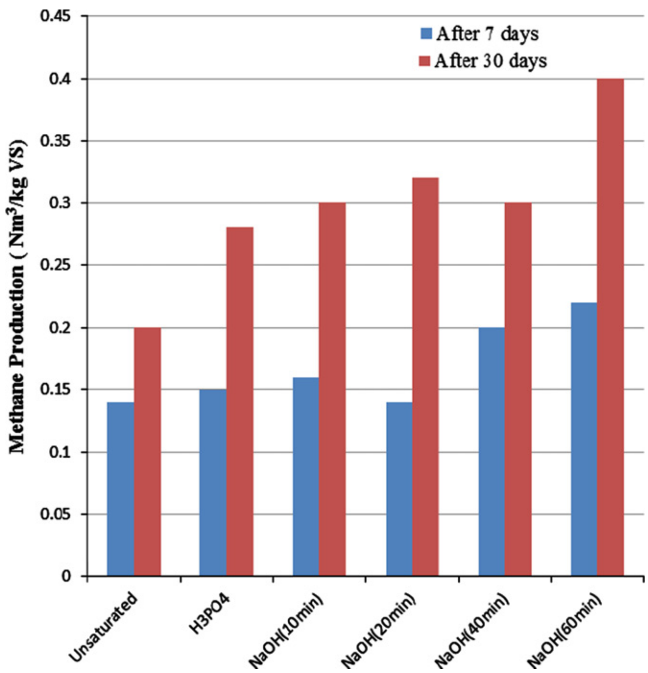

Fig. 1. Accumulated methane production (Nm^3/kg VS) from treated and untreated OPEFB after seven (grey bars) and 30 days (black bars) of anaerobic digestion [30].

Table 3
Characteristics of POME and discharge standard [47].

Parameters	POME (range)	POME (mean)	Discharge standard (1-1-1984 and thereafter)
Temperature (°C)	80–90	85	45
pH	3.4–5.2	4.2	5.0–9.0
Oil and grease	130–18,000	6000	50
BOD_3[a]	10,250–43,750	2,50,000	100
COD	15,000–1,00,000	51,000	–
Total solid	11,500–79,000	40,000	–
Suspended solid	5000–54,000	18,000	400
Total volatile solid	9000–72,000	34,000	–
Total nitrogen	180–1400	750	200[b]
Ammoniacal nitrogen	4–80	35	150[b]

All parameters are in mg L^{-1} except temperature and PH

[a] Sample is incubated for 3 days at 30 °C.
[b] Value of filtered sample.

bunches are generated as solid waste materials [40]. The annual Malaysian palm oil production has been recorded around 53 million tons and 13 million tons empty fruit bunches with moisture [41]. These valuable energy resources have attracted many investigators to work on the energy extraction from POME [42]. Currently, POME has been applied in most of palm oil industries as a feedstock to generate biogas in Malaysia [43,44]; however during low palm fruit seasons (December–February) the feedstock shortages have become a bottleneck for industries. Therefore some alternative feedstock should be prepared to develop the system all over the year. The suspension POME is containing 2–4% suspended solid, 95–96% water and around 1% oil. Palm fruit mesocarp debris is usually emerged in the shape of suspended solids from hydrocyclone waste, sludge separator and sterilizer condensate in milling process [45,46].In the year 2009 the total CPO production in Malaysia was recorded around 18 million tons and consequently around 44 million m^3 POME was generated [47]. Therefore, palm oil industry which was supposed to be green industry in Malaysia released the highest amount of pollution into rivers [48]. The highly amounts of BOD and COD in POME cause river pollution and serious environmental problems. The characteristics of POME in Malaysia and POME discharge standard limits to release into water sources have been shown in Table 3 [47].

Unfortunately, recent reports confirm that the standard of wastewater discharge is not observed by many palm oil factories and river pollution increases rapidly [49]. Hassan et al. [50]stipulated that POME same as municipal has an enormous potential to produce methane which can be burnt in boilers to generate electricity. It has been cited that anaerobic treatment in open-digesting or pond is the most efficient technology due to its extremely polluting characteristics. However, in most of the Malaysian factories the generated biogas is not captured and it escapes into the atmosphere directly due to the lack of knowledge and absence of suitable infrastructure in these industries. The global warming potential of methane is 21 times more than CO_2, therefore without suitable foundation the production of palm oil as a renewable source of energy cannot be considered as an environmental friendly process [51]. Based on the methodology proposed by Tong et al. [52] the rate of methane escaped to the atmosphere from POME in the year 2009 in Table 4 was estimated by Kee Lam et al. [10].

Earlier experimental investigations illustrate that carbon dioxide and methane in 35:65 ratio are the main anaerobic digestion POME end products which are known as GHG. Furthermore, the rate of methane emission was altered in variety POME treatment experiments [53]. Shirai et al.[54] and Yacob et al. [54] reported that methane emission was between 35% and 45% for threesome anaerobic treatment, which is conspicuously lower than the values reported by pioneers. The differences of methane emission from POME in various reports which are depicted in Table 5 are related to treatment methods applied in experiments [25].

It can be seen that the rate of emitted methane has been recorded between 0.15 and.042 L/g and the efficiency of COD removal 70–97%. Some parameters such as retention duration, organic loading rate, changing POME chemical properties and the amount of discharged volume are the main important items that create some differences in rate of methane emission in different experiments reported by various scientists. Fig. 2 depicts the rate of methane emission based on feedstock. This figure confirms that the rate of methane generated from POME is higher than municipal solid generation and biomass methane production [10].

Some valuable experiments have been done to improve the POME treatment such as modification of anaerobic fluidized bed reactor and anaerobic filter by Borja and Banks [55], the

Table 4
Emitted methane from POME at 2009 [10].

	Input parameters	Value
A	Total industrial output (million tons/year), crude palm oil	17.56
B	Degradable organic component (kg COD/m^3 POME)[a]	51
C	Wastewater produced (m^3 POME/tons CPO)[b]	3
D	Total organic in wastewater (million tons COD/year)[c]	2.69
E	Effective of COD removal by anaerobic digestion	0.85
Estimation of maximum methane emission from POME		
F	Maximum methane producing capacity (kg CH_4/kg COD)	0.25
G	Methane emission from POME (million tons CH_4/year)[d]	0.57
H	Methane emission from POME (million m^3 CH_4/year at 273° K)	799.61
I	GHG emission, CO_2-equivalent (million tons/year)[e]	11.99

[a] Assuming COD in POME input to anaerobic digestion at 50,000 mg/L.
[b] Assuming 0.6 m^3 POME/ton FFB; 0.2 ton CPO/ton FFB.
[c] $D=A*B*C$.
[d] $G=D*E*F$.
[e] Global warming potential of methane=21.

Table 5
Various reports of released methane from anaerobic POME digestion [25].

NO	Reactor type	Conditions	HRT (days)	Methane emission rate (L/methane/g COD removed)	COD removal efficiency	Reference
1	Single stage stirred digester	–	6.2	0.325	96%	[45]
2	Modified anaerobic baffled bioreactor	–	6	0.42	95%	[56]
3	Up-flow anaerobic sludge-fixed film (UASFF)	Mesophilic 38 °C	3	0.346	97%	[66]
4	Single stage	Mesophilic 37–42 °C	17	0.15[a]	97%	[67]
5	Continuous stirred tank reactor (CSTR)	Mesophilic 37 °C	7	0.3[a]	71%	[68]
6	Continuous stirred tank reactor (CSTR)	Thermophilc 55 °C	5	0.27[a]	70%	[68]

[a] Self-estimation.

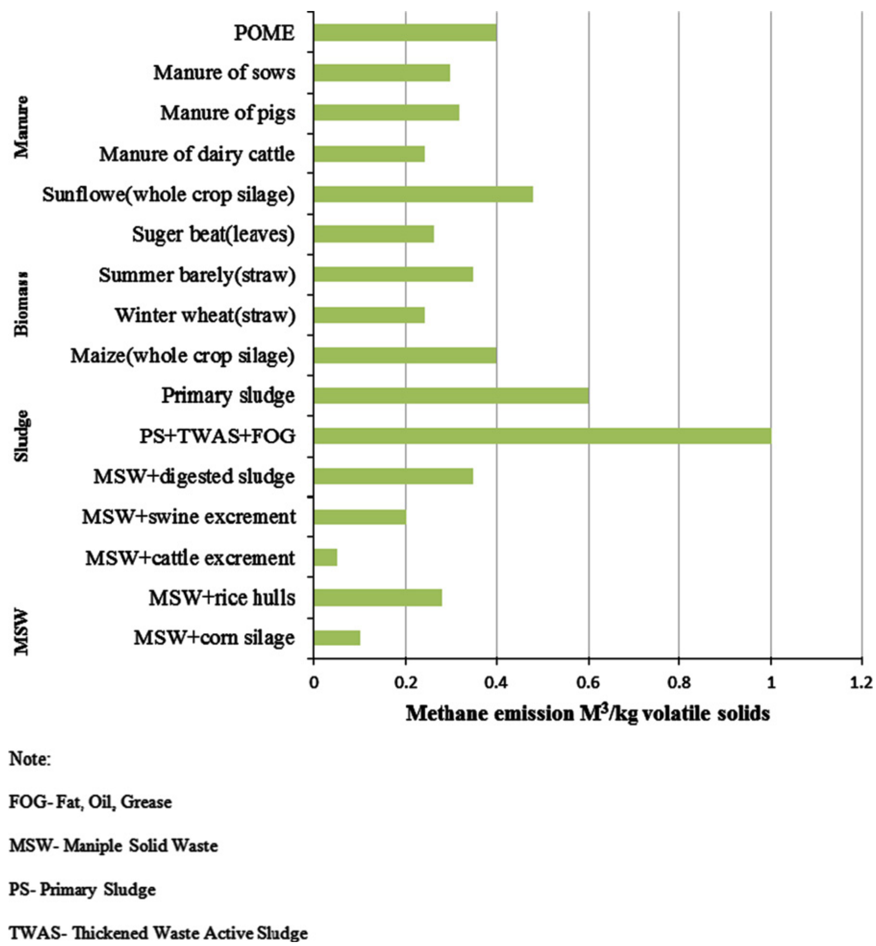

Fig. 2. Rate of methane emission based on feedstock [10].

upgrading anaerobic baffled bioreactor by Faisal and Unno [56], application of rotating biological contactors[40], thermophilic up flow anaerobic filter utilization to increase the efficiency and the results of aforementioned experiments shows better status than traditional methods [57].

4.1. Biogas production from pending system

The most common treatment mechanism for POME applied by palm oil factories in Malaysia is the pending system due to its low investment [52]. Anaerobic, algae aerobic puns and facultative are the main parts of pending systems. Limited condition monitoring and control as well as limited mixing are promising parameters to lead this system to low energy requirements [58]. Poh and Chong. [24] cited that the aerobic puns and facultative are the most important sections to further decline organic materials in waste-water before it is released to the river. In order to obtain desirable conditions in POME discharge, a large area is needed to install aeries of pending system. The pond depth plays crucial role in favorable biological process. Some optimum dimensions have been proposed to achieve the highest efficiency in POME treatment. For instance for 30–45 hydraulic retention time (HRT) the depth of anaerobic pond should be 5–7 m, for aerobic ponds atleast 0.5–1 m is required for 24 days HRT and 1–1.5 m depth is suggested for 15–20 days HRT [52,58]. Also, it has been shown that the anaerobic pond mechanism produces higher rate of methane emission compared to the digesting tank [27]. Shahrakbah et al. [3] investigated the methane production from POME anaerobic ponds in the mill by 54 t/h fresh fruit bunch (FFB) process capacity which was located in Negeri Sembilan in Malaysia. Four anaerobic

ponds, four algae ponds, two facultative anaerobic ponds, a cooling pond and a mixing pond constituted the main parts of that ponding system and the retention period was around 100 days. Fig. 3 depicts the top view diagram of anaerobic pond of that experiment schematically [3].

In this experiment the rate of methane production in the outer region was higher than inlet region due to excess accumulation of organic materials in the entrance of pond that would affect the methane production. Therefore the rate of methane production is lower than carbon dioxide in the inlet of pond [59]. Fig. 4 illustrates report of the rate of biogas and methane production in aforementioned pond during one year [3].

Lay et al. [60] reported that the rate of methane formation augments to static conditions of effluent inside ponds because hydrogen and carbon dioxide produced during the process are maintained longer in the liquid state. In these desirable conditions hydrogen-utilizing methanogens transform these gases into CH_4. Najafpour et al. [40] classified the biological waste pretreatments as suspended growth and attached growth methods. It has been claimed that when the flow rate of waste water has some fluctuations in organic loading and flow rate, the attached growth treatment is more stable than suspended growth treatment. Also, it has been reported that the organic biodegradation is affected by biomass disc [61,62].

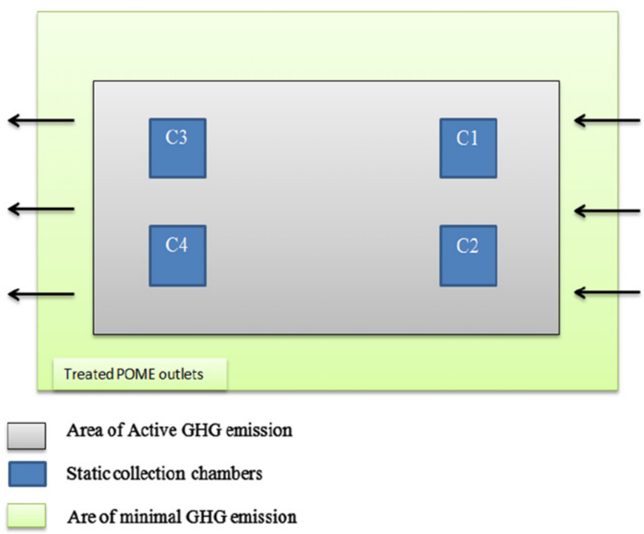

Fig. 3. Top view diagram of anaerobic pond [3].

4.2. Open digestion tanks

The typical digestion tanks which are made of steel with different capacities range from 600 to 3600 m^3 are usually applied when ponding systems are not feasible due to limited land. The HRT ranging for open digestion tank is 20–25 days which is shorter than ponding systems by 30–45 days HRT [24,58]. The solids which are agglomerated at the bottom of the tank can be easily removed and can be applied as fertilizer [52]. However, the effects of hydrogen sulfide on the exposed steel structure which are featured by corrosion are the most important disadvantages of open digestion tanks.

4.3. Closed digestion tanks

In recent years under the Clean Development Mechanism (CDM) strategy the closed anaerobic digestion tanks have been promoted. Biogas which is captured in this mechanism is directly applied as fuel in combustion process in power generation or boilers [52]. Carbon Emission Reduction (CER) strategy is easily obtained by applying closed digestion tanks compared to the open digestion tanks and open ponds. In the other word, the CER capability of latter aforementioned mechanisms is inconspicuous due to their open systems [63]. The designing of close digestion tanks and open digestion tanks is similar, but in closed digestion tanks some accessory equipment such as condition monitoring facilities, safety valves and cover are applied [58]. Tong and BakarJaafar. [52] claimed that the rate of extracted methane from closed digestion tanks is much higher than open ponds and open digestion tanks. Fig. 5 shows a closed digestion tank typically. The systems by three reactors by 7500 m^3 capacity and 18 HRT days are contained the agitators to stir tank reactor continuously [52]. Also, in order to intensify the mixing mechanism in this system, it has been equipped with gas lifting mixing and aided pump for circulation [64].This system has been worked over past 20 years continuously and it has illustrated its perfect capability and effectiveness.

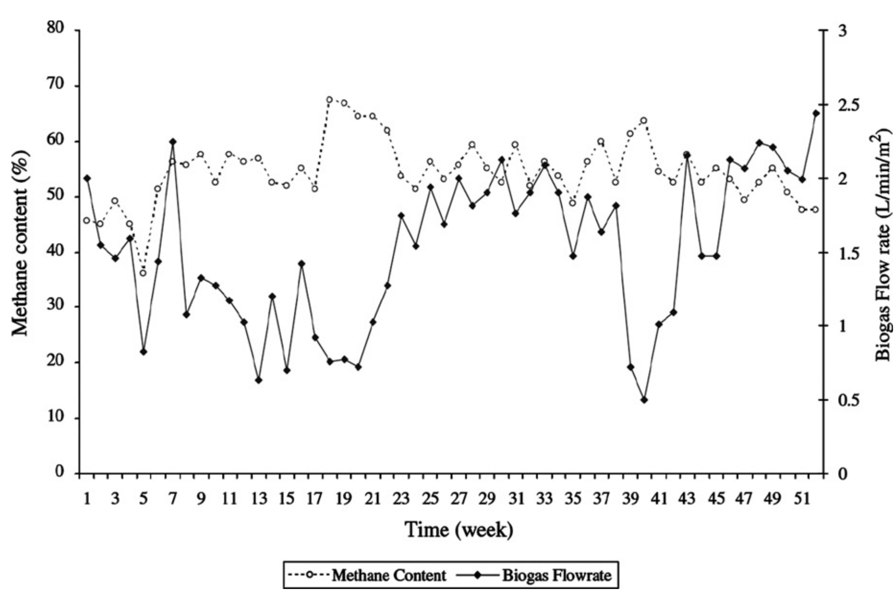

Fig. 4. Annual methane and biogas production profiles from anaerobic ponds [3].

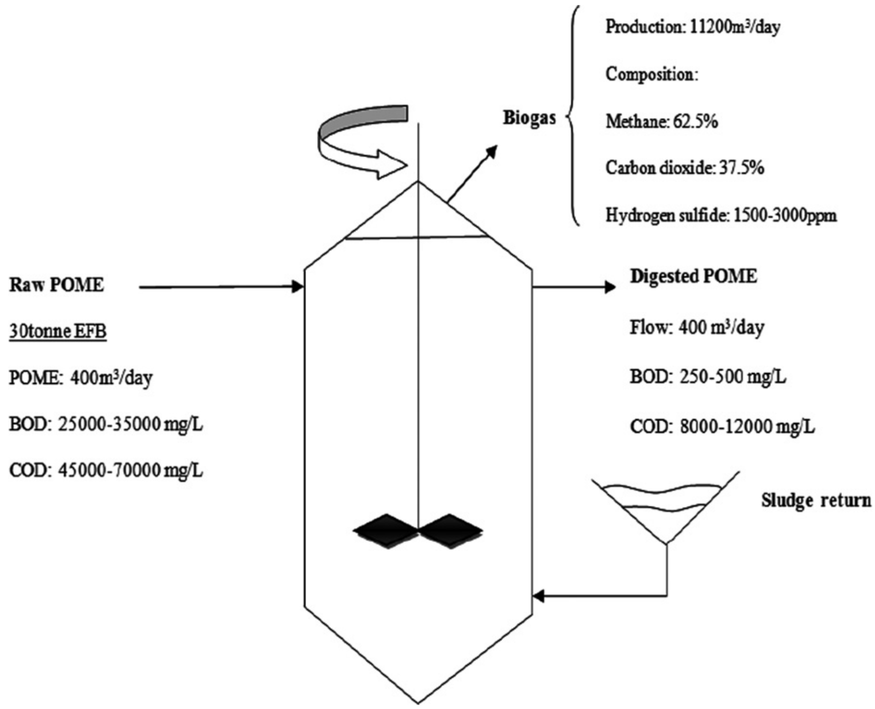

Fig. 5. Schematic of closed digestion tank [10].

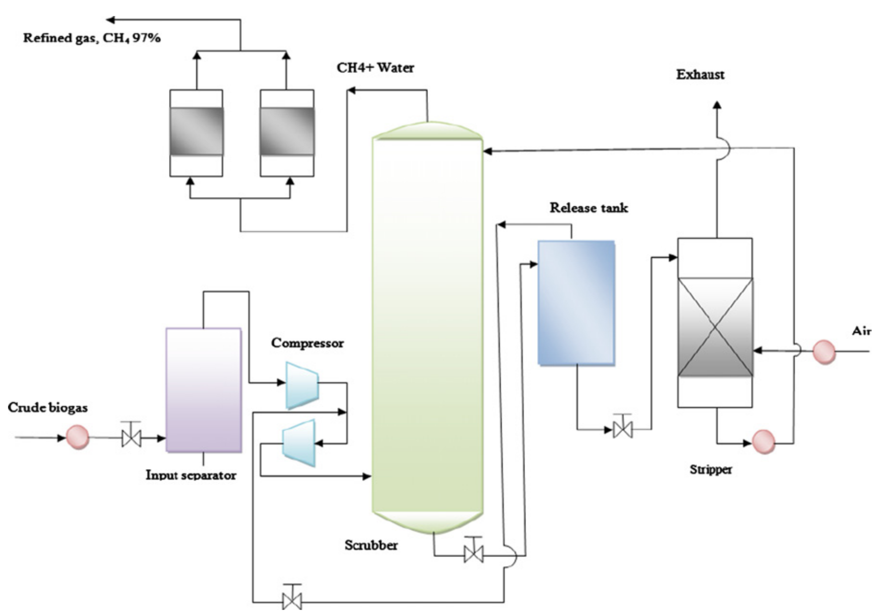

Fig. 6. Schematic of biogas refinery [10].

5. Biogas refinery

Investment in the refinery of biogas and its storage system by palm oil mills is the best strategy for environment protection and renewable energy achievement issues. The economic values of biogas production are more highlighted when this renewable fuel utilized in transportation and industrial sectors. Indeed, the palm oil mill sustainability is obtained by taking the biogas refinery strategy. In order to upgrade the biogas quality and the applied like compressed natural gas (CNG) in vehicles as a fuel it is necessary to be modified. The composition of methane should be more than 97%, CO_2 less than 3% by volume, H_2S less than 10 ppmv and water content should be less than 32 mg/Nm^3 [66]. Fig. 6 illustrates the upgrading biogas refinery plant diagram applying water scrubber mechanism schematically [10].

The pressurized crude biogas (8–12 bar) is charged to the bottom part of water scrubber where water absorbs CO_2 and H_2S contents of biogas. The exit gas from scrubber is conducted to an adsorption dryer system which consists of special adsorbing materials, and water is recirculated in desorption or stripper column. Eventually, the purified biogas is compressed to 250 bar and ready to distribute in refueling stations for vehicles. Apart from that, pressure swing adsorption (PSA) applying screen separation and molecular screen is mentioned as the common technology for biogas preferment [10].

6. Conclusion

Fossil fuel depletion and environmental pollution are the main problems emerged by more petroleum combustion and the necessity of finding alternative fuel as a renewable source of energy is observed. Recently, Malaysia has become one of the most important poles of biofuel technology in the world due to its huge palm trees jungles and wisely strategies which have been taken by Malaysian government. However, palm oil industry without appropriate sewage treatment not only wastes huge sources of renewable energy but also can be a menace for environment. In palm oil industries shell and mesocarp of the palm are mistakenly utilized as a fuel in the boilers to electricity generation. Actually, these valuable materials are incinerated instead of applying as renewable and sustainable fuel in industrial and transportation sectors. Lignocellulosic feedstock as a source of biofuel production has been developed and in closed future can be utilized as a renewable energy source with environmental friendly characteristics. Hemicellulosic and cellulosic parts in the lignin shield make a condensed structure for POEFB; therefore an appropriate method should be applied to degrade this structure to prepare hemicelluloses and cellulose for microbial decomposition. POEFB as a lignocellulosic waste material can be transferred to methane after suitable alkali pretreatment. Digestible materials can be achieved from some pretreatments on POEFB due to carbohydrates structure modification in these processes. POME is produced from the oil decoction, cleaning up and washing the millequipment and it would consist of fat, grease, oil and cellulosic particles. Simultaneous digestion of POME and POEFB in single treatment mechanism has so many economical and technical advantages. However, EFB lignocellulosic composition decreases the biodegradability of EFB and it is necessary to improve it before EFB application in biogas production. The performance of anaerobic pond mechanisms which has been applied by 90% of the Malaysian palm oil mills is better than open digesting tank systems. However, the best results in CO_2 and CH_4 capture has been shown in closed digesting tank. Some parameters like grinding activities and palm seasonal cropping which are the POME quantity and quality factors have significant influence on the methane emission template. The POME high capacity to generate methane can convince the Malaysian government to invest in infrastructures of palm oil industry to obtain renewable energy in sustainable ways with high commercial return.

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